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ABSTRACT

This exploratory study is concerned with identifying several measures of career attainment for psychologists and with relating these measures to Scholastic Aptitude Test (SAT) and Graduate Record Examination (GRE) scores and to other relevant characteristics. The basic hypothesis of the study is that abilities measured at the time of admission to college or graduate school are related to career performance after earning the doctorate. The analysis sample for this study included 215 psychologists who had earned a doctorate in psychology in 1963-64, who had earned a bachelor's degree between 1954 and 1961, and who had retrievable test scores either on the SAT or on the Aptitude Test and an Advanced Test of the GRE. Measures of attainment included citation counts obtained from the Social Sciences Citation Index and the Annual Review of Psychology, publication counts obtained from Psychological Abstracts, and election to fellow status in the American Psychological Association. The small sample sizes (128 for SAT and 150 for GRE) and the limitation to one field do not provide an adequate basis for generalization. The results, however, are sufficiently promising to warrant further research. They also suggest that GRE Advanced Test scores (which correlated .41 with citation counts from the Social Science Citation Index) may be more closely related to career performance than are measures of aptitude. (Author)

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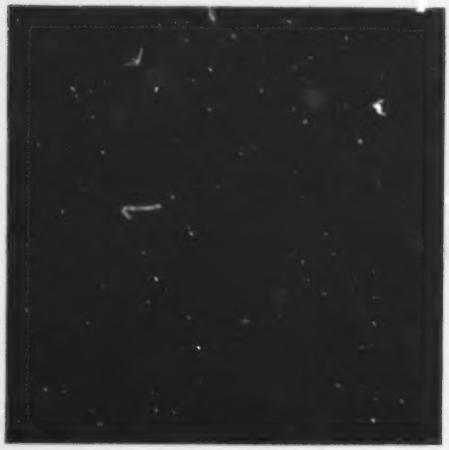

GRE

GRADUATE RECORD EXAMINATIONS

ADMISSIONS TEST SCORES AS PREDICTORS OF CAREER ACHIEVEMENT IN PSYCHOLOGY

William B. Schrader

GRE Board Research Report GREB No. 76-1R

September 1978

This report presents the findings of a research project funded by and carried out under the auspices of the Graduate Record Examinations Board.

EDUCATIONAL TESTING SERVICE, PRINCETON, NJ

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ADMISSIONS TEST SCORES AS PREDICTORS OF CAREER ACHIEVEMENT IN PSYCHOLOGY

William B. Schrader

GRE Board Research Report GREB No. 76-1R

September 1978

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ABSTRACT

This exploratory study is concerned with identifying several measures of career attainment for psychologists and with relating these measures to SAT and GRE scores and to other relevant characteristics. The basic hypothesis of the study is that abilities measured at the time of admission to college or graduate school are related to career performance after earning the doctorate.

The analysis sample for this study included 215 psychologists who had earned a doctorate in psychology in 1963-64, who had earned a bachelor's degree between 1954 and 1961, and who had retrievable test scores either on the SAT or on the Aptitude Test and an Advanced Test of the GRE.

Measures of attainment included citation counts obtained from the Social Sciences Citation Index and the Annual Review of Psychology, publication counts obtained from Psychological Abstracts, and election to fellow status in the American Psychological Association. The rating of the graduate faculty in Psychology for each psychologist's doctoral university as reported by Cartter (1966), along with various other biographical variables, was included in the study.

The small sample sizes (123 for SAT and 150 for GRE) and the limitation to one field do not provide an adequate basis for generalization. The results, however, are sufficiently promising to warrant further research. They also suggest that GRE Advanced Test scores (which correlated .41 with citations based on the Social Science Citation Index) may be more closely related to career performance than are measures of aptitude.

Admissions Test Scores as Predictors of Career Achievement in Psychology

Introduction

Many studies have shown that SAT and GRE are effective predictors of the kind of achievement that each was designed to measure--successful performance in college for SAT and successful performance in graduate work for GRE (Schrader, 1972; Willingham, 1974). Strictly speaking, studies of long-range performance are not directly relevant to evaluating these tests. The need for long-range studies is implicit, however, in Chauncey's (1962) statement: "While the interest of most people in the SAT is focussed on its ability to predict academic success in college, the significance of the test is really much more basic. It is a test that provides a great deal of information about two important qualities that have wide relevance in our society - verbal and mathematical ability." The present study should provide some information on the relation of SAT and GRE scores to career achievements of psychologists.

Critics of standardized testing and of meritocracy may point to the absence of solid data on long-range consequences of selection as evidence of a lack of broad social concern on the part of testers and test users, even though, strictly speaking, tests should be validated only in terms of their stated purposes. Long-range studies relating test scores to career achievement can hardly be expected to satisfy these critics. So many important decisions, significant experiences, and fortuitous events intervene between the time when admissions tests are taken and the time when career performance can be assessed that high correlations between test scores and career performance are unlikely to be found. What long-range studies can do is to provide evidence on whether a relationship between admissions test scores and performance exists despite all these obscuring influences. They can, in addition, throw some light on the contribution of the abilities measured by these tests to career performance in various fields.

Related Research

A number of studies have sought to relate test scores to career performance. In a survey concerned with aptitude tests and the highly able, Chauncey and Hilton (1965) located five studies that are related to the present study. One study, by Roe (1953) included the administration of short tests of verbal, mathematical, and spatial abilities to small but carefully chosen samples of biologists, physical scientists, and social scientists. She found that these scientists performed remarkably well on the tests, with some exceptions.

Chauncey and Hilton (1965) summarize a study by Kallop, who located College Board SAT scores for a number of persons listed in Who's Who in America or in American Men of Science. Both groups earned scores markedly higher than College Board candidates in general. Harmon (1959) obtained ratings on scientific achievement in 1959 of 355 fellowship candidates tested in 1948. For 219 fellowship awardees, and for the total group, he found relatively small (.21 to .28) but statistically significant correlation coefficients with the ratings for Quantitative scores and Advanced Test scores, but not for Verbal scores. For 136 scientists who did not receive an award, correlation coefficients were very low and not statistically significant. Terman and Oden (1959) in their major follow-up study of gifted children found only a modest difference in childhood IQ and in Concept Mastery Test scores in favor of adults rated as "successful" over a group as "unsuccessful." In the Terman and Oden study, all members of the sample had obtained intelligence test scores as children which placed them in the top 1% of their age group. Lastly, Taylor (1963) studied the relation of ratings of the creativity and productivity of research scientists to various tests. He found relationships between the ratings and the Concept Mastery Test which were not statistically significant. The Owens-Bennett (Form CC) Mechanical Comprehension Test, however, showed significant positive relations with the ratings.

In his classic study of American Psychologists, Clark (1957) did not have data on test performance. However, he did find that of his carefully defined group of significant contributors to psychology, 65% of the 1940-44 Ph.D. group reported that they were in the top 5% of their class in undergraduate work as compared with 37% of his comparison group of psychologists in general. Clark's study also provides a substantial amount of relevant data on various indicators of research productivity, as does a recent article by Porter and Wolfle (1975).

Wallach (1976) cites a number of studies, mainly exploratory in nature, in which various test scores did not differentiate between criterion groups defined by peer ratings. Studies of mathematicians by Helson and Crutchfield (1970), of graduate students by Bloom (1963) and of architects and scientists by MacKinnon (1968) show this pattern. Marston (1971) found that GRE scores did not predict productivity of psychologists. Results of a recent study by Clark and Centra (1978) also show little relationship between GRE scores and productivity. On the other hand, Creager (1966, 1967) found small but statistically significant correlations between GRE scores and productivity as measured by the number of times that the work of various National Science Foundation Fellowship applicants was cited.

Taken as a whole, these results suggest that the relationship between test performance and career achievement is not likely to be high when studies are based on highly selected groups. On the other hand, they suggest that the relationship between test performance and career achievement is high enough to warrant further research, especially if larger samples and better dependent variables than ratings can be identified.

Purpose

The primary purpose of this study was to find out whether persons who attain various forms of distinction within their field obtained higher SAT or GRE scores than were obtained by other persons in that field. All data were obtained from published materials and program files. To avoid any invasion of the privacy of the individuals included, detailed precautions were taken to prevent the identification of scores earned by any person included in the study, except by the staff members responsible for retrieving test scores from the microfilmed files.

Measures of Career Achievement

The value of this study depends in large measure on the indentification of career performance variables that fulfill at least three requirements:

(1) They should be acceptable to qualified judges as evidence of high-level intellectual performance;

(2) They should be clearly attributable to the efforts of the individual to whom they are credited; and

(3) They should be expressed in units that are reasonably comparable from one individual to another.

Scholarly activity as reflected in publications and citations, and election to fellow status provided suitable data for use as measures of individual achievement for psychologists. The quantification of these measures presented difficult but manageable problems. Particular attention was given to the strength and limitations of the Social Sciences Citation Index as a source of data on achievement.

Design of the Basic Sample

In defining the sample for this study, it was decided first that the sample be limited to psychologists who earned the doctorate in the same year. Making the amount of post-doctoral experience substantially the same for all members of the sample should make the measures of achievement more comparable from one member of the sample to another.

Using year of doctorate in defining the sample was appealing for two additional reasons. First, the attainment of a doctoral degree is a landmark in the career of a scholar or scientist. Second, if program validity studies are oriented toward the attainment of the doctorate, long-range studies of the relationship between test scores and career success should logically begin with that event. It was recognized that choosing the sample for each field in this way would be expected to restrict the range of talent in the study sample, and thus to result in lower observed correlations. This disadvantage

was thought to be balanced, at least in part, by the fact that career opportunities would be more nearly equal for all members of the sample if the group were limited to Ph.D.'s.

The choice of a specific interval between the doctorate and the assessment of attainment requires careful consideration. Clark's (1957) study of psychologists included psychologists who had earned the doctorate 10 or more years before his survey questionnaire was mailed. Ten years should provide an adequate amount of time for an individual to establish a career pattern. Centra (1974) found that mean ages of attaining the doctorate in fields other than education ranged from 29 for men in physical sciences to 35 for women in social sciences and in humanities. A ten-year interval beyond the doctorate would result in an average age for the sample of about 40. It seems reasonable that most psychologists' career patterns are reasonably well established by the time they reach 40.

On the basis of the foregoing considerations, the base sample for this study was defined as the 979 persons listed in American Doctoral Dissertations as having earned a doctorate in psychology in 1963-64. A decision to limit the sample to persons whose doctorate was earned in a United States graduate school reduced the number to 962.

Biographical data from an American Psychological Association directory or from American Men and Women of Science were considered essential both for identification in score retrieval and for the data analysis. This requirement resulted in the exclusion of 126 persons. In addition, 28 persons for whom year of bachelor's degree, date of birth, or both were not available were not included in the sample.

For a number of reasons, it seemed desirable to limit the analysis sample to psychologists who had earned a bachelor's degree between 1954 and 1961. First, this limitation made the group more homogeneous with respect to years of post-baccalaureate experience and, to a lesser extent, with respect to age. It seemed likely that records of publications and citations would be more nearly comparable from one member of the sample to another if persons who took more than nine years between the bachelor's degree and the doctorate were excluded from the analysis sample. That there is wide variation in the lapse of time between the bachelor's and doctor's degrees for different individuals has been shown by Wilson (1965) and Centra (1974). Second, although there would be some interest in studying the group whose bachelor's degrees were earned prior to 1954, the fact that both the College Board and GRE programs expanded rapidly during the post-World War II period suggested that too few scores would be found for this group to provide a useful basis for comparison. Third, this limitation facilitated the systematic search of the score files, and made it unnecessary to take account of the redefinition of the GRE score scales introduced in the fall of 1952.

Finally, it was decided to include clinical psychologists who held a faculty position in a college or university but to exclude 157 clinicians not so employed. This step was taken because it was thought that many clinicians in nonacademic settings would make their main professional contribution in other ways than in publication. After this step, the base sample size was 428.

Of the 428 psychologists in the defined sample, score data were obtained for 215. Of these, 128 were in the SAT sample and 150 were in the GRE sample. (63 psychologists were in both samples.)

In summary, the analysis sample may be described as including psychologists who earned their doctorate in 1963-64, who earned a bachelor's degree in 1954 or later, and who had scores on SAT or GRE. It seems likely that psychologists who took SAT or GRE and who earned the doctorate in a reasonable amount of time beyond their bachelor's degree are higher and more homogeneous in ability than the total group of 1963-64 doctorates in psychology.

Description of Variables

Of the variables for which data were obtained in this study, 15 were judged to be of primary interest. Variables of secondary interest are described in the Appendix, which also includes results for these supplementary variables. The variables included in the main study are:

University: Cartter Group

The university where the psychologist earned a doctorate was categorized on the rated quality of the graduate faculty in psychology as reported by Cartter (1966). This variable will be called the Cartter Group. The following codes were used in the analysis:

5 = "Distinguished"

4 = "Strong"

3 = "Good"

2 = "Adequate plus"

1 = not listed

The "Distinguished" group included 6 universities, the "Strong" group included 17, the "Good" group included 14 and the "Adequate plus" group included 23.

University: Carnegie Group

The university where the doctorate was earned was also categorized on the basis of the classification published by the Carnegie Commission on Higher Education (1973). This variable will be called the Carnegie Group. The following codes were used in preparing the data:

4 = "Research Universities I"

3 = "Research Universities II"

2 = "Doctoral - Granting Universities I"

1 = All other U.S. universities

Because 77% of the psychologists in the sample had earned doctorates at universities in the "Research Universities I" group, this variable was dichotomized to contrast that group with all others, treating the "Research Universities I" group as "1" and all others as "0".

Type of Position

In the data preparation, codes were assigned on the basis of recent biographical information obtained from the 1975 APA biographical Directory or the 12th edition of American Men and Women of Science, as follows:

1 = Associate professor or higher rank in a college or university

2 = Other position in a college or university

3 = Research position

4 = All others or no recent data

For psychologists who engaged in both academic and nonacademic employment (e.g., private practice), the code was based on the academic position.

In the analysis, psychologists having a rank of associate professor or higher were treated as having a score of "1" and all others a score of "0" on this variable. Clearly, this variable merely distinguishes between persons who progressed in an academic career and others who followed a different career pattern or whose status was unknown. It was not intended to serve as an indicator of level of achievement.

Citations: SSCI

Total number of citations to the psychologist's work in the 1972, 1973, 1974, and 1975 volumes of the Social Sciences Citations Index was the measure for this variable. Self-citations were included in the count.

Citations: SSCI Normalized

Because number of citations in SSCI was skewed to an extreme degree, it was considered desirable to "normalize" the distribution by grouping the total sample into 10 groups and to assign the mean normal deviate for the category as its scale value. (Normal deviates were expressed on a scale having a mean of 50 and a standard deviation of 10, for convenience. The actual mean of the normalized citation scores was 49.9 and the standard deviation was 9.9 for the 215 members of the total analysis sample.) The following table shows the ten intervals, the percentage of the group in each interval, and the scale value.

Number of Citations (SSCI)	Percent in Group	Scale Value
200-493	5.1	71
90-199	4.7	64
46-89	10.7	60
26-45	9.3	57
16-25	11.2	54
12-15	10.2	51
7-11	11.2	48
3-6	10.2	45
1-2	10.2	42
0	17.2	35

Citations: Annual Review

The number of page references in the index of the Annual Review of Psychology for the period 1965 to 1975 inclusive was the indicator for this variable. Authors of a chapter were credited with one citation for the chapter as a whole in addition to specific page references to their own work in the chapter.

Publications: Total

The total number of publications listed for the psychologist from Volume 41 (1967) through Volume 51 (1975) of Psychological Abstracts was obtained using the retrieval service maintained for Psychological Abstracts by APA.

Publications: First Author

The number of publications included in "Publications: Total" that listed the psychologist as sole or senior author was obtained from the Psychological Abstracts listing.

APA Fellow

Fellow status in APA (coded "1") was obtained from the 1975 APA Biographical Directory and from the June 1976 and June 1977 issues of the American Psychologist.

SAT-Verbal

SAT-Verbal is a test designed to measure reading comprehension and other verbal abilities designed for use in college admissions.

SAT-Mathematical

This test is a measure of mathematical abilities designed for use in college admissions. It emphasizes ability to deal with mathematical relationships rather than formal course preparation.

GRE-Verbal

This test is a measure of reading comprehension and other verbal abilities designed for use in graduate school admissions.

GRE-Quantitative

This test is a measure of quantitative ability designed for use in graduate school admissions. Like SAT-Mathematical, it emphasizes ability to handle mathematical relationships rather than formal mathematical achievement.

GRE-Advanced

GRE Advanced Tests for various fields are designed to measure achievement in courses likely to be included in a college major in a particular academic field. In this study, a psychologist's Advanced Test score was used even if it were in a field other than psychology. In all, 6 of the 150 psychologists in the GRE sample had taken a test in a different field.

Special Issues in Data Preparation

By far the most critical question in the data preparation effort was the risk that test scores, publications, or citations would be associated with a member of the sample that should, in fact, be attributed to some other person having a similar name.

The problem of identification was most acute with respect to the Social Sciences Citation Index, which uses only initials and which includes many fields besides psychology and thus multiplies the danger of faulty attribution. For purposes of the present study, it seemed desirable to work with the printed version of the index, so that information on the journal or other publication in which each cited article appeared was conveniently available. It appeared that computer printouts obtainable from the retrieval service in use at ETS provided too little or too much information for effective use. In many instances, a reasonable judgment could be made to separate genuine from faulty attributions for a particular psychologist. The additional data in the printed copy turned out to be reassuring with respect to the great majority of citations but at the same time turned up a number of citations that were difficult to classify, assuming that psychologists are versatile and that their interests change over time. It was possible to resolve substantially all of the doubtful instances satisfactorily by reference to Psychological Abstracts, the original article, or some other source. This effort was time-consuming and costly, and may have had little effect on the results. It seems clear, however, that precautions against faulty attribution are needed when citations are used in research studies, particularly when, as in the present study, the number of citations is of primary interest.

The identification of test scores also presented a problem because of the large number of records in the files and because it was considered likely that a large proportion of the sample would not have taken the tests because many colleges and universities did not require SAT or GRE. For this reason, the risk of faulty matches between scores and names was a matter of particular concern. Date of birth was, in general, not available in the score files for the years of interest. For GRE, college attended provided a very useful basis for supplementing the name. In some instances, testing center served as a check on identity. For SAT, the main basis for supplementary identification was graduation from a college that was a College Board member college at the time the person was tested. Students whose bachelor's degree was earned at other colleges were included in the sample only if they had been tested within 3 to 5 years of their bachelor's degree and if some confirmatory evidence of their identity could be found. For example, home addresses were compared for persons having scores on both SAT and GRE. As it turned out, it was decided that five persons should be excluded from each sample because it was judged that the sample member was different from the person who earned the scores.

Like the Social Studies Citation Index, the Annual Review of Psychology uses only initials in identifying cited articles. Moreover, references to many articles are identified in the text only by number so that although junior authors are listed in the index, it is often difficult to locate the particular article that was cited. For this variable, the total number of pages on which an author was mentioned was used as the indicator of citations. The author of a chapter was credited with one citation for the chapter, plus the number of self-citations included in the chapter.

A further problem in identification arose for women who married between the time that they took the SAT and the present. In some instances, the maiden name was found in an American Psychological Association directory, and more were found by treating the woman's middle name as a maiden name. The latter procedure was particularly useful in locating SAT scores for women who had married before earning a doctorate.

The publication count based on Psychological Abstracts presented few difficulties of identification except for junior authors. In general, the first name was given in full and the affiliation of the senior author was given. These data provided a much more satisfactory basis for identification than did the limited information given by the citation index.

A final, relatively minor difficulty may be mentioned. For various reasons, citations may not precisely reproduce the last name and initials of the author, resulting in too low a citation count. A reasonable effort was made to locate additional citations, particularly to work that appeared in the main listing for a psychologist.

In summary, the difficulties encountered in preparing the data for analysis were somewhat greater than had been anticipated. It appears, however, that satisfactory solutions to the various problems were obtained. It should also be stressed that the complexities in using the citation index are greatly outweighed by the contribution made by its systematic and comprehensive search of the literature. Indeed, the use of citations as a measure would hardly be feasible if the index did not exist.

Results

Correlations of Test Scores with Background Variables

The central results of this study appear in the five columns at the right of Table 1, which shows the correlations of the five test scores with three background variables, and with six measures of achievement.

Considering the background variables first, correlations with quality ratings of graduate faculty range from .28 for GRE-Quantitative to .38 for GRE Advanced. The correlations with the Carnegie Commission on Higher Education grouping of universities range from .21 for GRE-Quantitative to .30 for SAT-Verbal. These results suggest that high test scores are indeed related to enhanced access to more prestigious institutions. The closeness of relationship is, however, not very great.

With respect to a contrast between psychologists who have progressed in an academic career to an associate professorship or higher rank and the remainder of the group, correlations range only from -.07 to .10 in the SAT and GRE samples. Thus, the psychologists in

Table 1

Intercorrelations of Background Variables, Measures of Achievement, and Test Scores

(Based on 128 members of the SAT sample and 150 members of the GRE sample)[a]

Variable[b]	Sample	University		Type of Position	Citations			Publications		APA Fellow	Test Scores				GRE Advanced
		Cartter Group	Carnegie Group		SSCI	SSCI Normalized	Annual Review	Total	First Author		SAT-V	SAT-M	GRE-V	GRE-Q	
University: Cartter Group	SAT	--	.65	.09	.26	.38	.27	.21	.18	.11	.34	.30			
	GRE	--	.65	.13	.29	.44	.32	.22	.25	.15			.37	.28	.38
University: Carnegie Group	SAT	.65	--	-.06	.08	.19	.10	.04	.02	.01	.30	.27			
	GRE	.65	--	.05	.11	.35	.14	.07	.13	.03			.29	.21	.24
Type of Position	SAT	.09	-.06	--	.23	.27	.22	.31	.27	.16	-.07	-.01			
	GRE	.13	.05	--	.21	.35	.23	.32	.26	.13			.00	-.01	.10
Citations: SSCI	SAT	.26	.08	.23	--	.71	.72	.58	.63	.45	.16	.26			
	GRE	.29	.11	.21	--	.73	.74	.64	.71	.37			.27	.31	.41
Citations: SSCI Normalized	SAT	.38	.19	.27	.71	--	.56	.67	.69	.40	.16	.17			
	GRE	.44	.35	.35	.73	--	.61	.67	.67	.36			.30	.24	.47
Citations: Annual Review	SAT	.27	.10	.22	.72	.56	--	.52	.47	.45	.14	.15			
	GRE	.32	.14	.23	.74	.61	--	.55	.51	.48			.21	.32	.34
Publications: Total	SAT	.21	.04	.31	.58	.67	.52	--	.90	.44	-.02	.12			
	GRE	.22	.07	.32	.64	.67	.55	--	.89	.43			.18	.29	.32
Publications: First Author	SAT	.18	.02	.27	.63	.69	.47	.90	--	.32	-.03	.15			
	GRE	.25	.13	.26	.71	.67	.51	.89	--	.32			.15	.28	.31
APA Fellow	SAT	.11	.01	.16	.45	.40	.45	.44	.32	--	.11	.04			
	GRE	.15	.03	.13	.37	.36	.48	.43	.32	--			.02	.11	.04
SAT-Verbal	SAT	.34	.30	-.07	.16	.16	.14	-.02	-.03	.11	--	.49			
SAT-Mathematical	SAT	.30	.27	-.01	.26	.17	.15	.12	.15	.04	.49	--			
GRE-Verbal	GRE	.37	.29	.00	.27	.30	.21	.18	.15	.02			--	.53	.61
GRE-Quantitative	GRE	.28	.21	-.01	.31	.24	.32	.29	.28	.11			.53	--	.41
GRE Advanced	GRE	.38	.24	.10	.41	.47	.33	.32	.33	.04			.61	.41	--
Mean	SAT	3.49	.80	.63	45.0	50.6	3.9	8.8	6.0	.16	568	566			
	GRE	3.15	.77	.64	33.4	49.6	3.2	8.3	5.4	.13			617	594	612
Standard Deviation	SAT	1.25	.40	.48	92.3	10.1	6.7	10.0	7.3	.37	97	88			
	GRE	1.35	.42	.48	61.3	9.9	5.3	9.6	6.8	.34			98	105	94

[a]Significance levels: For SAT, the 5% level is .17; the 1% level is .23. For GRE, the 5% level is .16; the 1% level is .21.

[b]Variables are described on pages 5 to 8.

this sample who followed a usual academic career do not differ appreciably with respect to scores from the remainder of the group.

Correlation of Test Scores with Measures of Achievement

Because the sample sizes for the two groups are relatively small, considerable variation in results from one criterion measure to another would be expected to arise from sampling fluctuations. Nevertheless, in view of the importance of the choice of measure of achievement for studies of this kind, a fairly detailed comparison will be made.

Against the total citations, as obtained from the Social Sciences Citation Index, coefficients range from .16 for SAT-Verbal to .41 for GRE Advanced. For the Advanced Test and for the SAT and GRE quantitative tests, the correlations between test scores and achievement are about as high as the correlation between these scores and admission to a more prestigious psychology department, but the SAT and GRE verbal scores are somewhat more highly correlated with admissions than with achievement. All but one of the five correlations with SSCI citations are significant at the 1% level. Results of this study are reasonably similar to those obtained by Creager (1966) between GRE scores and citations for 73 psychologists. The relevant correlations in the two studies are as follows:

	Creager	Present Study
GRE-Verbal	-.03	.27
GRE-Quantitative	.23	.31
GRE Advanced	.33	.41

In this study, a different measure of citations was developed, as described on page 7, by grouping the total sample of 215 psychologists into ten groups on the basis of number of citations and then assigning the mean normal deviate for each group to all members of that group. This procedure, in essence, utilizes the actual number of citations only to assign a rank order to each person and uses the resulting ordering to produce a measure of citations that was distributed approximately normally. In general, it was thought that normalizing this variable would reduce the effect of the small number of persons who had a large number of citations on the correlational results.

In that SAT sample, the correlation between observed and normalized citations was .71; for the GRE sample, the corresponding figure was .73. Comparison of the outcomes of normalized with observed measures of citations showed that although there were appreciable differences between results for the two ways of expressing the citation data, there

was no clear pattern in the differences. Among 19 comparisons shown in Table 1, the correlation was higher for the normalized variable in 11 instances, with one tie. Although the question of transforming citation (and publication) data deserves further exploration, it was decided that the observed data on citations would be emphasized in interpreting the results of the present study.

When references in the Annual Review of Psychology are taken as the measure of achievement, the correlation with Advanced Test scores drops to .33 while the correlation with GRE-Quantitative is .32.

Results for both total publications and publications in which the psychologist was the first (or only) author are similar to results for annual review citations for Advanced Test scores and slightly lower for two quantitative tests. Correlations for GRE-Verbal, however, are noticeably lower (from .21 to .18 and .15) and for SAT-Verbal are markedly lower (from .14 to -.02 and -.03) when the two measures of publications rather than annual review citations are taken as the measure of achievement.

Finally, correlations with election to fellow status in APA were uniformly low, ranging from .02 to .11. It appears that psychologists who attained this status in a relatively short time after earning the doctorate do not differ appreciably in test scores from the remainder of the sample.

The similarity of results for the SAT and the GRE Aptitude Test is a matter of interest because the two tests are designed for somewhat different purposes and are administered at different stages of an individual's educational career. This similarity suggests that differences between the tests and differences among individuals in the development of abilities during the college years do not have much effect on correlations with the measures included in this study.

A point of some methodological interest concerns the effect of limiting the GRE sample to the 144 psychologists who had Psychology Advanced Test scores. As it turned out, the correlation of the Advanced Test scores with SSCI citations decreased from .41 to .40 and with normalized citations from .47 to .43 when six psychologists who took an Advanced Test other than Psychology were removed. Interestingly enough, the correlation of GRE-Verbal with citations increased from .27 to .37 while its correlation with normalized citations remained the same. Correlations of GRE-Quantitative with normalized citations decreased by .02 but remained the same for citations. For the present study, it was decided to use the larger sample as the basis for the report.

Correlations of Background Variables with Measures of Achievement

Like test scores, the quality ratings of psychology faculty reflected in the Cartter groups showed a modest correlation with publications and

citations. Against the four main measures of productivity, the correlations with the Cartter quality ratings were as follows:

Achievement Measure	SAT Sample	GRE Sample
SSCI Citations	.26	.29
Normalized SSCI Citations	.38	.44
Annual Review Citations	.27	.32
Total Publications	.21	.22

These positive correlations, like those reported earlier between Cartter quality ratings and test scores, may be considered quite reasonable if it is assumed that psychology departments having high quality ratings attract and select high ability students and emphasize publication in their graduate programs. These results raise the possibility that the positive correlations between test scores and achievement are attributable, at least in part, to the role that the scores play in access to the kind of training offered by departments with high quality ratings. No fully satisfactory method of evaluating this effect is available. It is possible, however, to calculate partial correlations between test scores and criterion measures holding Cartter quality ratings constant statistically. The interpretation of these partial correlations is complicated by the fact that differences in student ability level between departments may affect the correlation between the Cartter quality ratings and the attainment measures. To the extent that this occurs, the partial correlations would overestimate the effect of controlling for differences in Cartter quality ratings. It is also true, of course, that if a different measure of departmental quality were used, the resulting partial correlations would be different. Despite these limitations, the coefficients shown in Table 2 may be considered to be reasonable estimates of the correlation between test scores and attainment measures when effects attributable to differences in department quality as measured by Cartter ratings are removed statistically. For the partial correlations, 10 of the 20 coefficients are significant at the 5% or 1% level, as compared with 14 of 20 of the original coefficients. The four partial coefficients for the Advanced Tests are all significant at the 1% level.

Results shown in Table 1 for type of position indicate that this variable shows a modest correlation with productivity measures and

Table 2

Partial Correlations between Test Scores and Selected Measures of Achievement when Cartter Group is Held Constant[a]

Test Score	Citations			
	SSCI	SSCI Normalized	Annual Review	Total Publications
SAT-Verbal[b]	.08(.16)	.04(.16)	.05(.14)	-.08(-.02)
SAT-Mathematical[b]	.20(.26)	.06(.17)	.08(.15)	.06 (.12)
GRE-Verbal[c]	.18(.27)	.16(.30)	.10(.21)	.11 (.18)
GRE-Quantitative[c]	.25(.31)	.14(.24)	.25(.32)	.24 (.29)
GRE Advanced[c]	.34(.41)	.36(.47)	.24(.33)	.26 (.32)

[a]Original correlation coefficients between the variables are shown in parentheses.

[b]Sample size for SAT is 128. Significance levels: The 5% level is .17; the 1% level is .23.

[c]Sample size for GRE is 150. Significance levels: The 5% level is .16; the 1% level is .21.

little or none with test scores. This suggests that differences in occupational roles may lower somewhat the correlation between scores and productivity. A more refined measure of occupation would be helpful in evaluating this effect.

Some Methodological Questions

The design of this study provided comparisons of citation scores with normalized citation scores, of the Cartter groupings with the Carnegie groupings, and of total publications with "first-author" publications.

With respect to raw vs. normalized citation scores, the correlation between the two measures is .71 for the SAT sample and .73 for the GRE sample. Correlations of the normalized scores are noticeably higher with the three background variables. They are higher with total publications but lower with annual review citations and with fellow status in APA. On the whole, the results suggest that normalization or a logarithmic transformation of citation scores is worth further study, particularly in research depending on correlational analysis.

Results for the Cartter and Carnegie groupings suggest that the Cartter groupings are preferable for studies of this kind, especially because in the Carnegie groupings, a large majority (80% of the SAT sample and 77% of the GRE sample) belonged to the same group.

Finally, results for total publications vs. "first-author" publications show a correlation of .90 for the SAT group and .89 for the GRE group. The correlation of "first-author" publications with SSCI citations is .05 higher for the SAT group and .07 higher for the GRE group than the corresponding total publications, as might be expected because SSCI citations are based on "first-author" publications only. When SSCI citations are normalized, however, the difference virtually disappears. Results for other variables suggest that little additional information is yielded by the distinction between the two publication measures. On the whole, total publications seems preferable because it is based on more information.

Mean Scores on Selected Variables for Subgroups

Table 3 shows mean scores on SSCI citations, normalized SSCI citations, annual review citations, total publications, SAT scores, and GRE scores for psychologists whose major field of specialization belonged to a group sufficiently large to justify calculating mean scores. It is noteworthy that the Social and Personality group had appreciably more citations than the Comparative/Animal, Experimental, and Physiological group but that for total publications the difference was in the opposite direction. The Clinical, Community, and Counseling group was somewhat less productive and had somewhat lower scores than the other two groups.

Table 3

Means of Measures of Achievement and Test Scores of Psychologists Classified by Major Field

Variable	Sample	Major Field: Clinical Community Counseling	Comparative/Animal Experimental Physiological	Personality Social	All Others
Citations: SSCI	SAT	23.2	30.2	90.4	44.4
	GRE	5.7	35.6	56.4	30.8
Citations: SSCI Normalized	SAT	45.7	52.3	55.6	50.0
	GRE	45.2	52.8	54.2	47.6
Citations: Annual Review	SAT	1.8	2.7	4.6	5.5
	GRE	2.5	2.8	4.3	3.4
Publications: Total	SAT	3.8	12.6	9.4	8.9
	GRE	4.3	13.4	9.2	6.5
SAT-Verbal	SAT	546	559	595	573
SAT-Mathematical	SAT	551	561	572	576
GRE-Verbal	GRE	595	626	639	612
GRE-Quantitative	GRE	565	602	600	602
GRE Advanced	GRE	582	633	646	597
N	SAT	27	29	23	49
	GRE	32	39	27	52

Table 4 shows mean scores for psychologists grouped on the basis of the Cartter ratings of faculty quality. All variables studied show a clear upward trend although there are several instances in which the mean for a group exceeds that of the group receiving the next higher rating. It may be noted that the "Strong" group excels the "Distinguished" group on mean publications; on citations, however, the "Distinguished" group is noticeably higher.

Table 5 shows means and standard deviations for psychologists grouped by SAT scores. For SAT scores the relatively good performance of the "Below 500" groups is a matter of some interest, as is the high citation scores for the "650 and above" group. Table 5 also shows that normalizing the citation scores yields standard deviations for the three groups on each test that are much more similar than the corresponding standard deviations for raw citation scores.

Table 6, based on GRE scores, also shows relatively good performance for the "Below 500" and remarkably high performance for the "700 and above" group. Further studies would be needed, of course, to find out whether this pattern is characteristic or is mainly a function of the samples of the present study.

Summary and Conclusions

Among the many potential determiners of scholarly productivity in psychology, abilities as measured at the time of college or graduate school admission are especially well suited to statistical study. Because these scores may be considered comparable for students attending different colleges and universities, they can be used in a national study. A substantial amount of time had elapsed since the 1950's, when testing gained widespread acceptance for college and graduate school admissions. Thus, it is possible to find test scores for psychologists who have had sufficient time beyond the doctorate to provide a reasonable measure of their productivity.

The development of citation indices provides an opportunity to estimate the usefulness of a psychologist's contributions as evaluated by his or her professional colleagues. Although publications constitute one measure of a person's productivity, citations may be considered to provide a superior measure of the effect of his or her work on the field. The fact that there are many aspects of a psychologist's contribution that are not reflected in citations should not obscure the importance of the particular aspect measured, with some approximation, by the number of citations.

Table 4

Means of Measures of Achievement and Test Scores of Psychologists Classified by Cartter Group

Variable	Sample	Cartter Group Based on Quality of Faculty				
		Other	Adequate Plus	Good	Strong	Distinguished
Citations: SSCI	SAT	15.4	11.7	26.8	54.2	79.4
	GRE	11.5	10.8	29.9	41.7	65.4
Citations: SSCI normalized	SAT	47.4	47.4	46.0	53.2	56.0
	GRE	43.9	45.7	46.7	53.2	55.8
Citations: Annual Review	SAT	1.3	1.8	2.8	4.0	6.3
	GRE	1.2	1.2	2.5	4.3	6.1
Publications: Total	SAT	4.3	6.4	7.3	11.3	10.4
	GRE	5.3	5.3	7.8	10.9	10.0
SAT-Verbal	SAT	463	561	554	587	601
SAT-Mathematical	SAT	516	533	558	576	598
GRE-Verbal	GRE	557	591	611	640	666
GRE-Quantitative	GRE	538	598	563	626	624
GRE Advanced	GRE	568	582	580	639	672
N	SAT	11	16	34	33	34
	GRE	27	21	29	49	24

Table 5

Measures of Achievement of Psychologists Classified by SAT Scores

Variable	SAT-Verbal Score					
	Below 500		500-640		650 and above	
	Mean	SD	Mean	SD	Mean	SD
Citations : SSCI	42.0	97.6	27.6	57.0	81.8	124.3
Citations: SSCI Normalized	50.9	8.9	49.1	9.1	53.4	12.1
Citations: Annual Review	2.8	3.8	3.7	7.2	5.5	7.8
Publications: Total	9.5	10.1	8.6	10.1	8.4	9.4
N	34		62		32	

Variable	SAT-Mathematical Score					
	Below 500		500-640		650 and above	
	Mean	SD	Mean	SD	Mean	SD
Citations: SSCI	41.6	75.6	37.4	87.6	72.2	116.4
Citations: SSCI Normalized	51.8	9.5	49.2	5.9	53.7	10.4
Citations: Annual Review	3.7	6.4	3.6	7.0	5.2	5.9
Publications: Total	9.9	11.0	7.8	8.9	10.2	11.0
N	32		72		24	

Table 6

Measures of Achievement of Psychologists Classified by GRE Scores

Variable	GRE-Verbal Score					
	Below 500		500-690		700 and above	
	Mean	SD	Mean	SD	Mean	SD
Citations: SSCI	26.7	50.8	26.2	57.5	58.3	72.9
Citations: SSCI Normalized	47.9	10.0	48.9	8.7	53.5	11.1
Citations: Annual Review	3.2	5.6	2.7	4.2	4.5	6.7
Publications: Total	6.8	8.6	8.5	9.7	9.8	10.1
N	40		77		33	

Variable	GRE-Quantitative Score					
	Below 500		500-690		700 and above	
	Mean	SD	Mean	SD	Mean	SD
Citations: SSCI	25.6	38.0	21.0	34.6	81.1	109.5
Citations: SSCI Normalized	48.9	9.4	47.9	8.8	55.6	11.0
Citations: Annual Review	2.2	3.5	2.8	3.8	6.5	8.9
Publications: Total	7.1	8.3	6.8	7.0	14.8	13.9
N	52		71		27	

Variable	GRE Advanced Score					
	Below 500		500-690		700 and above	
	Mean	SD	Mean	SD	Mean	SD
Citations: SSCI	35.0	60.4	17.2	25.5	70.0	95.6
Citations: SSCI Normalized	48.8	10.4	47.5	8.4	55.8	10.0
Citations: Annual Review	3.7	6.4	2.3	3.5	4.8	6.5
Publications: Total	6.3	7.8	7.6	8.6	12.6	11.9
N	39		78		33	

The main focus of the present study is on the relation of SAT scores and GRE scores to citations, as determined from the Social Sciences Citation Index. The study included other measures describing the individual and the institution at which the doctorate was earned, and other measures of career achievement, including election to fellow status in the American Psychological Association. The samples for this study were limited to psychologists who received a doctorate in psychology from a U.S. university in 1963-64, who earned a bachelor's degree between 1954 and 1961, and who were not engaged solely in clinical practice. Of psychologists in the defined sample, SAT scores were retrieved for 128 and GRE aptitude and advanced scores were retrieved for 150. These samples were judged to be sufficiently large to permit a preliminary evaluation of the relation of abilities measured by SAT and GRE to important aspects of career performance.

On the whole, the results of the study indicate that abilities measured at the time of college or graduate school admission are indeed related to career productivity. The correlation of the GRE Advanced Test score with citations was relatively high ($r = .41$). Correlations of citations with the other four scores ranged from .16 to .31. Correlations of scores with number of publications listed in Psychological Abstracts ranged from -.02 (for SAT-Verbal) to .32 (for GRE Advanced). Correlations with election to fellow status in APA were low, ranging from .02 to .11.

Although the samples in this study are too small to justify detailed comparisons or broad generalizations, the results appear to warrant further research based on data for other years and for other fields.

APPENDIX

Data were collected for a number of variables not included in the main study. Results for these variables together with the variables included in the main study are shown in Tables A1, A2, and A3.

The following variables were obtained from an APA Biographical Directory (1975, 1973, 1970, or 1968 edition) or from American Men and Women of Science.

Year of Bachelor's Degree

Year of Birth

Member of APA (1975 Biographical Directory)

Held postdoctoral fellowship

Listed in American Men and Women of Science

The following variable was obtained from the classification of colleges and universities published by the Carnegie Commission on Higher Education.

Public (coded "0"), Private (coded "1")

The following variables were obtained from computer printouts supplied by American Psychological Association, based on Psychological Abstracts for Document Years 1967 through 1975.

Publications: Sole Author

Publications: Senior Author

Publications: Junior Author

Table A1

Intercorrelations of Personal Characteristics and Test Scores

Variable[a]	Sample[b]	Year of AB	Year of Birth	University: Cartter Group	University: Carnegie Group	University: Public-Private	Post-doctoral Fellow	Member, APA	Listed, AMWS	Type of Position	SAT-V	SAT-M	GRE-V	GRE-Q	GRE Advanced
Year of Bachelor's	SAT	--	.81	.11	.15	-.15	.15	-.13	.12	-.01	-.05	.19			
	GRE	--	.56	.16	.08	-.10	.19	-.12	.18	.07			-.05	.15	.07
Year of Birth	SAT	.81	--	.18	.18	-.12	.06	-.09	.10	-.03	.11	.26			
	GRE	.56	--	.16	-.05	-.03	.13	-.07	.14	.05			-.07	.11	.08
University															
Cartter Group	SAT	.1	.18	--	.65	.02	.10	-.04	.17	.09	.34	.30			
	GRE	.16	.16	--	.65	.01	.15	-.17	.13	.13			.37	.28	.38
Carnegie Group	SAT	.15	.18	.65	--	-.09	.06	.00	.04	-.06	.30	.27			
	GRE	.08	-.05	.65	--	-.02	.10	.06	.07	.05			.29	.21	.24
Public-Private	SAT	-.15	-.12	.02	-.09	--	-.10	.12	-.03	-.10	.02	.03			
	GRE	-.10	-.03	.01	-.02	--	-.07	.15	-.06	-.16			.10	.16	.15
Postdoctoral Fellow	SAT	.15	.06	.10	.06	-.10	--	-.04	.30	.24	.05	-.02			
	GRE	.19	.13	.15	.10	-.07	--	.02	29	.22			-.04	.03	.05
Member, APA	SAT	-.13	-.09	-.04	.00	.12	-.04	--	-.03	.12	-.02	.04			
	GRE	-.12	-.07	-.17	.06	.15	.02		-.02	.05			.08	.07	.02
Listed, AMWS	SAT	.12	.10	.17	.04	-.03	.30	-.03	--	.36	.14	.18			
	GRE	.18	.14	.13	.07	-.06	.29	-.02	--	.48			.15	.18	.26
Type of Position	SAT	-.01	-.03	.09	-.06	-.10	.24	.12	.36	--	-.07	-.01			
	GRE	.07	.05	.13	.05	-.16	.22	.05	.48	--			.00	-.01	.10
SAT-Verbal	SAT	-.05	.11	.34	.30	.02	.05	-.02	.14	-.07	--	.49			
SAT-Mathematical	SAT	.19	.26	.30	.27	.03	-.02	.04	.18	-.01	.49	--			
GRE-Verbal	GRE	-.05	-.07	.37	.29	.10	-.04	.08	.15	.00			--	.53	.61
GRE-Quantitative	GRE	.15	.11	.28	.21	.16	.03	.07	.18	-.01			.53	--	.41
GRE Advanced	GRE	.07	.08	.38	.24	.15	.05	.02	.26	.10			.61	.41	--
Mean	SAT	58.1	36.0	3.49	.80	.45	.24	.80	.65	.63	568	566			
	GRE	57.8	35.1	3.15	.77	.47	.19	.84	.69	.64			617	594	612
Standard Deviation	SAT	1.7	2.0	1.25	.40	.50	.43	40	.48	.48	97	88			
	GRE	1.7	3.2	1.35	.42	.50	.39	37	.47	.48			98	105	94

[a] Variables are described on pages 5 to 8.

[b] Sample size: SAT, 128; GRE 150. Significance levels: For SAT, the 5% level is .17; the 1% level is .23. For GRE, the 5% level is .16; the 1% level is .21.

Table A2

Intercorrelations of Measures of Achievement

Variable	Sample[a]	Citations			Publications					
		SSCI	SSCI Normalized	Annual Review	Sole Author	Senior Author	First Author	Junior Author	Total	APA Fellow
Citations: SSCI	SAT	--	.71	.72	.52	.54	.63	.25	.58	.45
	GRE		.73	.74	.61	.59	.71	.29	.64	.37
Citations: SSCI Normalized	SAT	.71	--	.56	.57	.60	.69	.35	.67	.40
	GRE	.73	--	.61	.51	.62	.67	.39	.67	.36
Citations: Annual Review	SAT	.72	.56	--	.33	.48	.47	.37	.52	.45
	GRE	.74	.61	--	.33	.53	.51	.40	.55	.48
Publications:										
Sole Author	SAT	.52	.57	.33	--	.44	.86	.17	.71	.16
	GRE	.61	.51	.33	--	.43	.84	.12	.66	.17
Senior Author	SAT	.54	.60	.48	.44	--	.83	.43	.81	.39
	GRE	.59	.62	.53	.43	--	.85	.51	.85	.37
First Author	SAT	.63	.69	.47	.86	.83	--	.35	.90	.32
	GRE	.71	.67	.51	.84	.85	--	.37	.89	.32
Junior Author	SAT	.25	.35	.37	.17	.43	.35	--	.73	.43
	GRE	.29	.39	.40	.12	.51	.37	--	.75	.40
Total	SAT	.58	.67	.52	.71	.81	.90	.73	--	.44
	GRE	.64	.67	.55	.66	.85	.89	.75	--	.43
APA Fellow	SAT	.45	.40	.45	.16	.39	.32	.43	.44	--
	GRE	.37	.36	.48	.17	.37	.32	.40	.43	--
Mean	SAT	45.0	50.6	3.9	3.0	3.0	6.0	2.8	8.8	.16
	GRE	33.4	49.6	3.2	2.3	3.1	5.4	3.0	8.3	.13
Standard Deviation	SAT	92.3	10.1	6.7	4.5	4.1	7.3	4.7	10.0	.37
	GRE	61.3	9.9	5.3	4.0	4.0	6.8	4.7	9.6	.34

[a]Sample size: SAT, 128; GRE, 150. Significance levels: For SAT, the 5% level is 17; the 1% level is .23. For GRE, the 5% level is .16; the 1% level is .21.

Table A3

Correlations of Personal Characteristics and Test Scores with Measures of Achievement

Variable	Sample[a]	Citations			Publications					APA Fellow
		SSCI	SSCI Normalized	Annual Review	Sole Author	Senior Author	First Author	Junior Author	Total	
Year of Bachelor's	SAT	.27	.24	.17	.26	.26	.31	.18	.31	.16
	GRE	.27	.27	.16	.28	.26	.32	.15	.30	.16
Year of Birth	SAT	.28	.25	.18	.16	.25	.24	.18	.26	.20
	GRE	.20	.21	.12	.18	.18	.21	.09	.19	.13
University										
Cartter Group	SAT	.26	.38	.27	.16	.14	.18	.17	.21	.11
	GRE	.29	.44	.32	.25	.17	.25	.10	.22	.15
Carnegie Group	SAT	.08	.19	.10	-.01	.04	.02	.06	.04	.01
	GRE	.11	.35	.14	.12	.09	.13	-.04	.07	.03
Public-Private	SAT	-.11	-.15	.00	-.14	-.12	-.16	-.05	-.14	-.10
	GRE	.06	.05	.12	-.09	.10	.00	.14	.07	.07
Postdoctoral Fellow	SAT	.08	.20	.20	.19	.09	.16	.10	.17	.09
	GRE	.11	.21	.17	.18	.09	.16	.14	.18	.16
Member, APA	SAT	-.05	-.13	.03	-.20	-.01	-.12	.06	-.06	--
	GRE	.11	-.08	.01	-.20	.01	-.11	.12	-.02	--
Listed, AMWS	SAT	.19	.31	.13	.23	.05	.17	.17	.21	.11
	GRE	.16	.32	.11	.18	.15	.20	.23	.25	.10
Type of Position	SAT	.23	.27	.22	.23	.23	.27	.24	.31	.16
	GRE	.21	.35	.23	.17	.26	.26	.29	.32	.13
SAT-Verbal	SAT	.16	.16	.14	.04	-.10	-.03	-.01	-.02	.11
SAT-Mathematical	SAT	.26	.17	.15	.14	.10	.15	.02	.12	.04
GRE-Verbal	GRE	.27	.30	.21	.10	.15	.15	.14	.18	.02
GRE-Quantitative	GRE	.31	.24	.32	.25	.22	.28	.20	.29	.11
GRE Advanced	GRE	.41	.47	.33	.25	.31	.33	.18	.32	.04
Mean	SAT	45.0	50.6	3.9	3.0	3.0	6.0	2.8	8.8	.16
	GRE	33.4	49.6	3.2	2.3	3.1	5.4	3.0	8.3	.13
Standard Deviation	SAT	92.3	10.1	6.7	4.5	4.1	7.3	4.7	10.0	.37
	GRE	61.3	9.9	5.3	4.0	4.0	6.8	4.7	9.6	.34

[a] Sample size: SAT, 128; GRE, 150. Significance levels: For SAT, the 5% level is .17, the 1% level is .23. For GRE, the 5% level is .16; the 1% level is .21.

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